What is a Variable?

- Simply, something that varies.
- Specifically, variables represent persons or objects that can be manipulated, controlled, or merely measured for the sake of research.

- Variation: How much a variable varies. Those with little variation are called *constants*.

Examples of Variables

- In any election, the variables that may have played a part would include:
  - Voter Turnout
  - Party Message
  - # of Open Seats
  - Redistricting
  - # of Incumbents
  - Sympathy

Dependent v. Independent Variables

cause/effect manner.

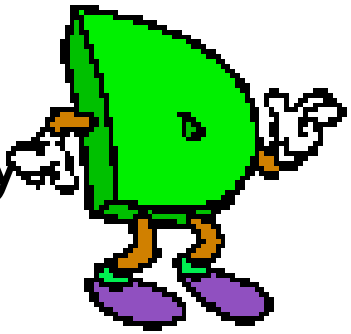
independent (i.e., cause)

dependent (i.e., effect)

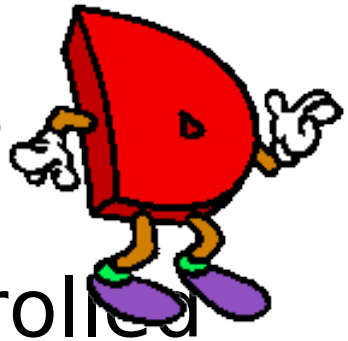
Example: What affects a student's arrival to class?

Variables:

- Type of School
  - Liberals Arts v. University
- Type of Student
  - Athlete? Gender? GPA?
- Time
  - Bedtime, Waking, Arrival
- Mode of Transportation



Dependent Variables



- Dependent variables are not controlled or manipulated in any way, but instead are simply *measured* or *registered*.
- These vary in relation to the independent variables, and while results can be predicted, the data is always measured.
- There can be any number of dependent variables, but *usually* there is *one* to isolate reason for variation.

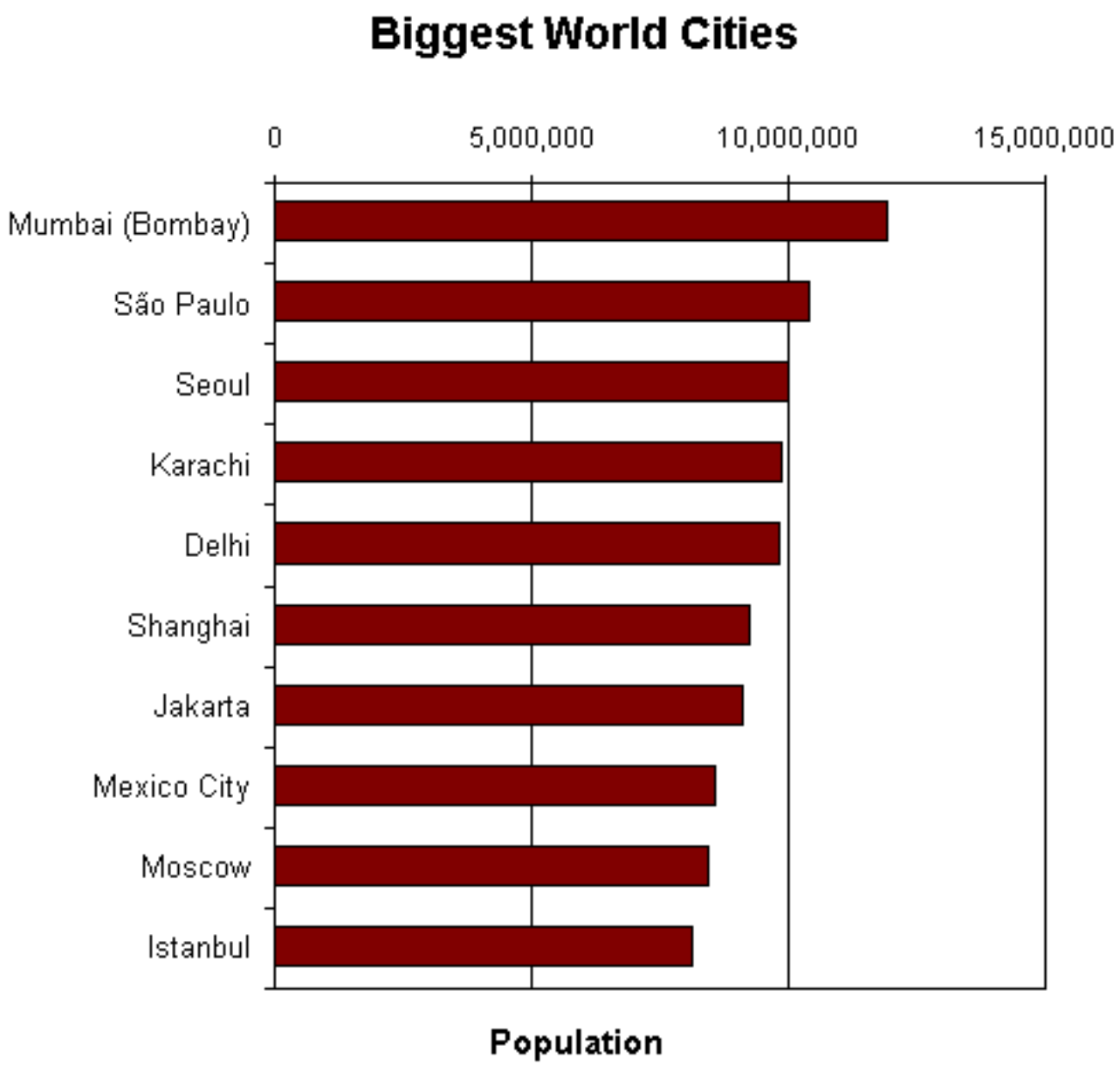
Independent Variables

- These variables are ones that are *more or less controlled*.
- Scientists *manipulate* these variables as they see fit.
- They still vary, but the *variation* is relatively *known* or taken into account.
- Often there are *many* in a given study.

Independent V. Dependent

- Intentionally manipulated
- Controlled
- Vary at known rate
- Cause

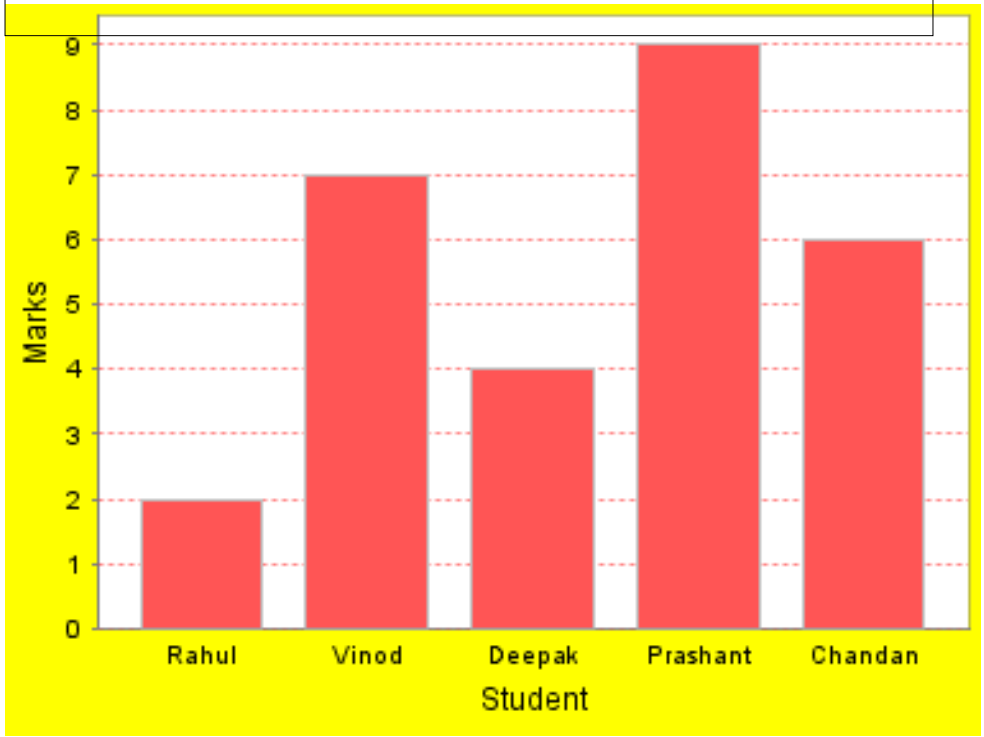
- Intentionally left alone
- Measured
- Vary at unknown rate
- Effect

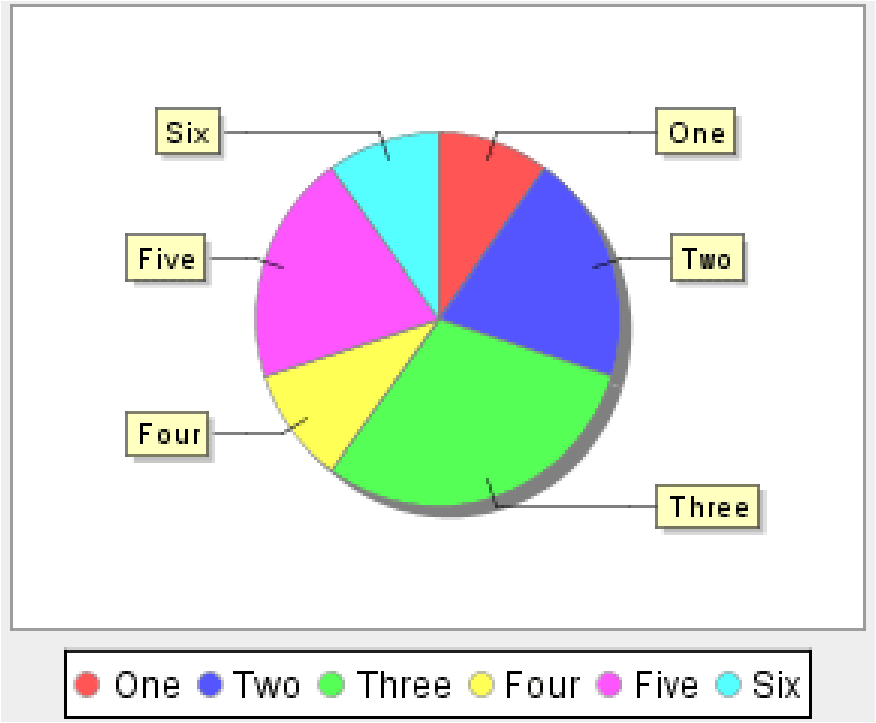

Biggest World Cities
0
5,000,000
10,000,000
15,000,000
Mumbai (Bombay)
São Paulo
Seoul
Karachi
Delhi
Shanghai
Jakarta
Mexico City
Moscow
Istanbul
Population

Bar Graph

Bar Charts: This is a type of chart, which contains labeled horizontal or vertical bars showing a piece of information and an axis. The numbers along the side of bar graph compose the axis. This is also called as a **histogram;** Bar Graph is useful when there is a **numerical comparison.**

Pie Charts: A pie chart is a type of a **circle graph** normally used in showcasing a **wholesome quantity**; we have to show that how this whole quantity is broken into parts. The whole quantity depicts entire sample space and the pieces of pie in the circle graph are called sectors



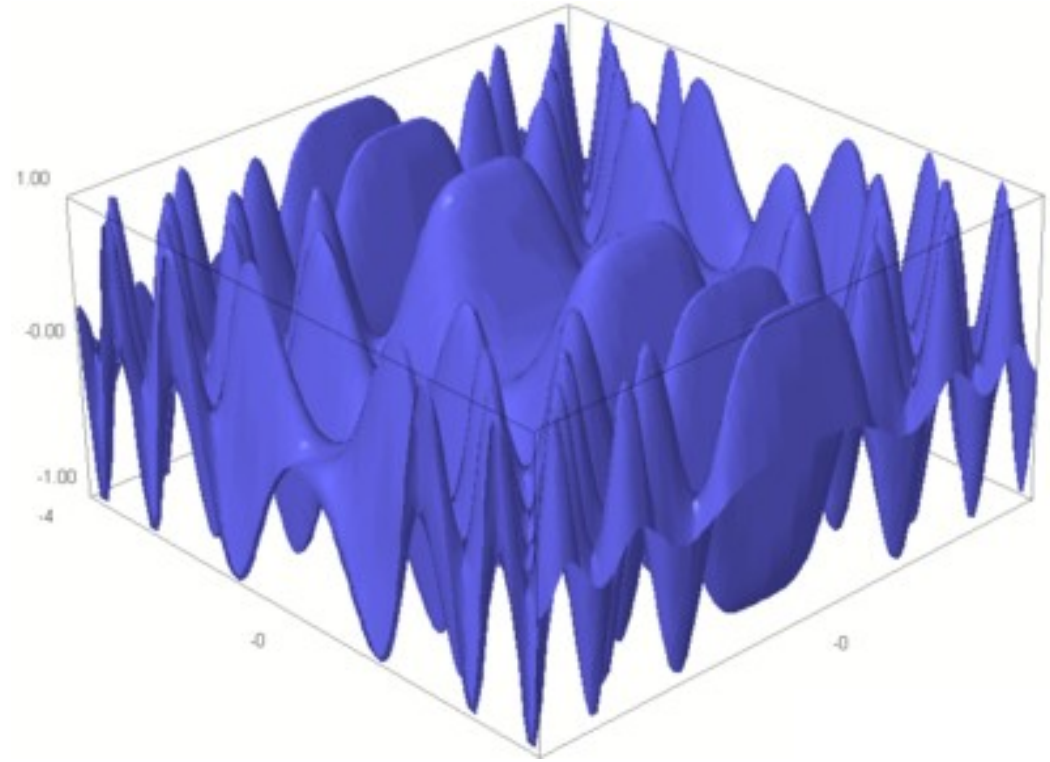


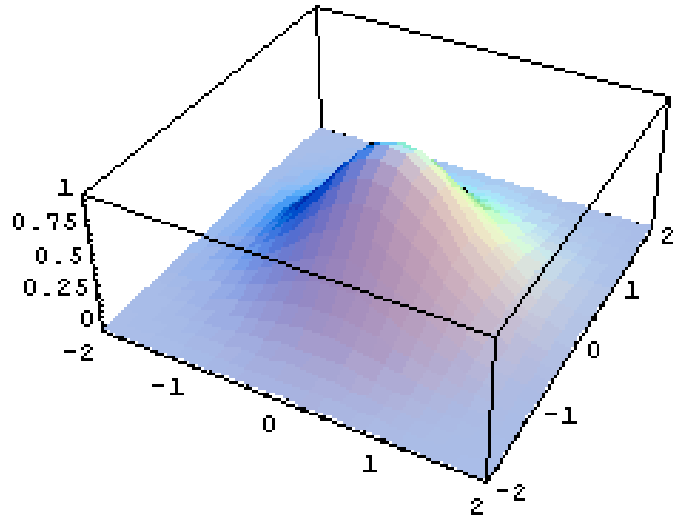
Bar Graph

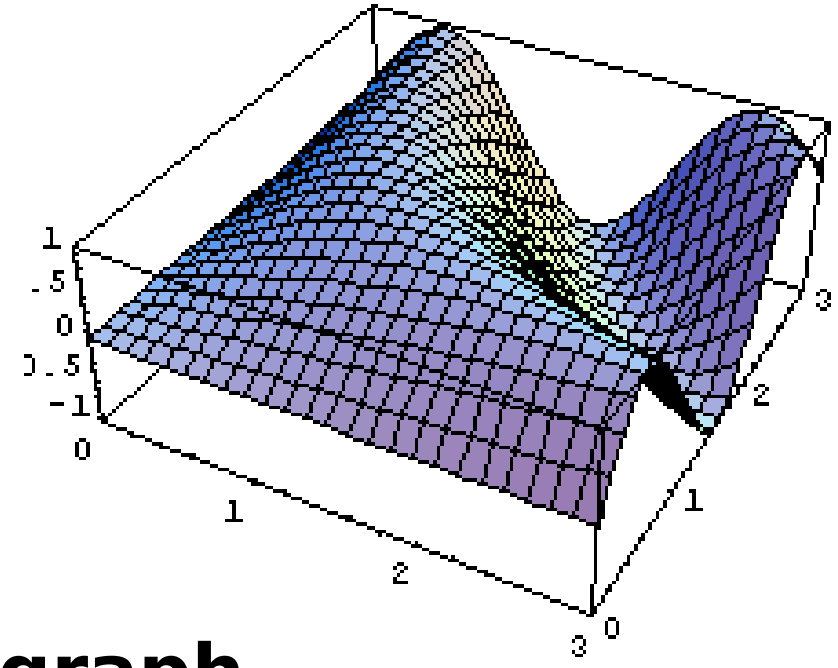
Pie Charts

Source:

Source: wolfram.com







-Dimensional Surface graph

Rules for plotting Graphs

The proper construction of a graph from tabulated data can be generalized into a series of steps.

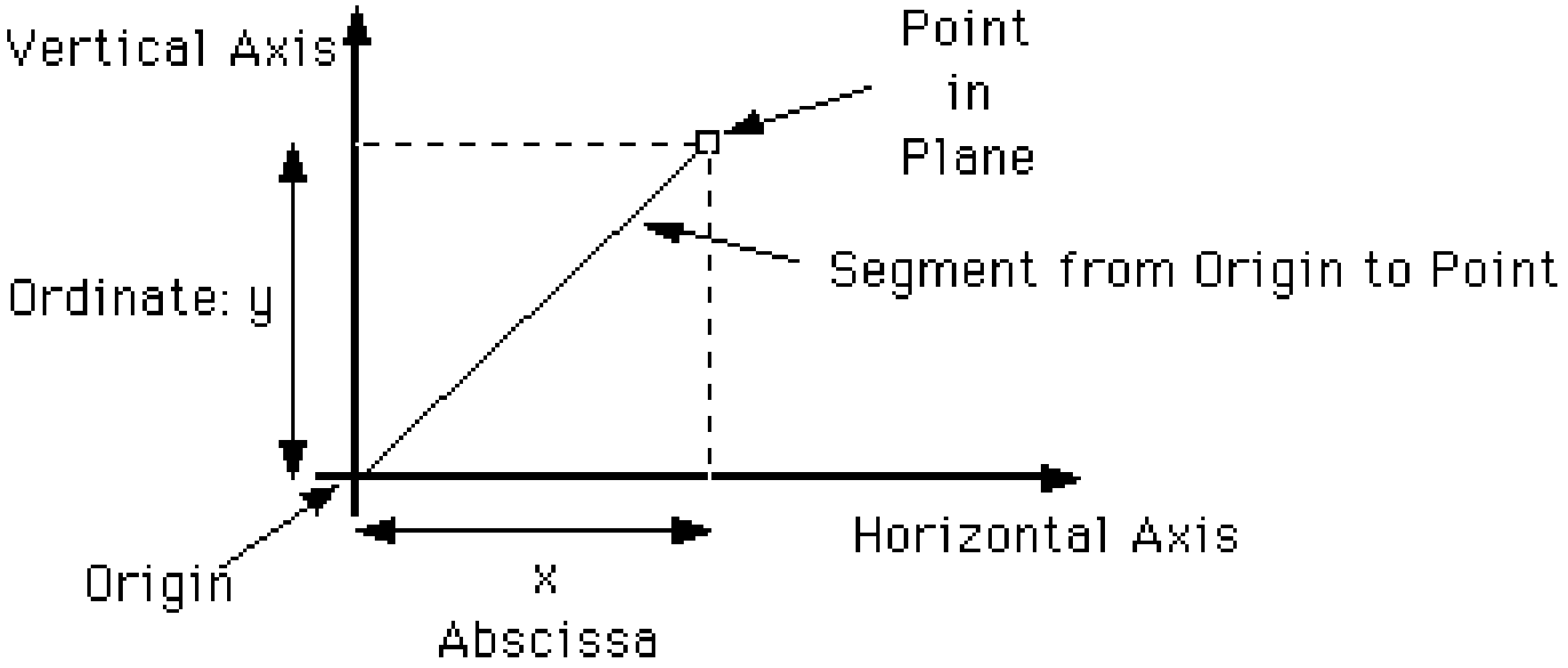
1. Select the correct type of graph paper (rectilinear, log-log, semi-log, polar graph) and grid spacing.
2. Choose the proper location of the horizontal and vertical axes.
3. Determine the scale units for each axis so that the data can be appropriately displayed.
4. Graduate and calibrate the axes.
5. Identify each axis completely.
6. Plot the data points and use permissible symbols (that is, ones commonly used and easily understood).
7. Draw the curve or curves.
8. Identify each curve and add the other necessary notes.
9. Darken lines for good reproduction.

The smallest graduations on the scale are selected to follow the 1, 2, 5 rule – meaning that if the number were written in scientific notation, the mantissa would be 1, 2, or 5.

Note that the dependent variable is plotted on the ordinate (y-axis) and the independent variable is plotted on the abscissa (x-axis). When describing the graph, we say the dependent variable is plotted versus the independent variable.

The ordinate and abscissa must have labels with units

NOTE:
X-AXIS→ INDEPENDENT VARIABLE
Y-AXIS→ DEPENDENT VARIABLE



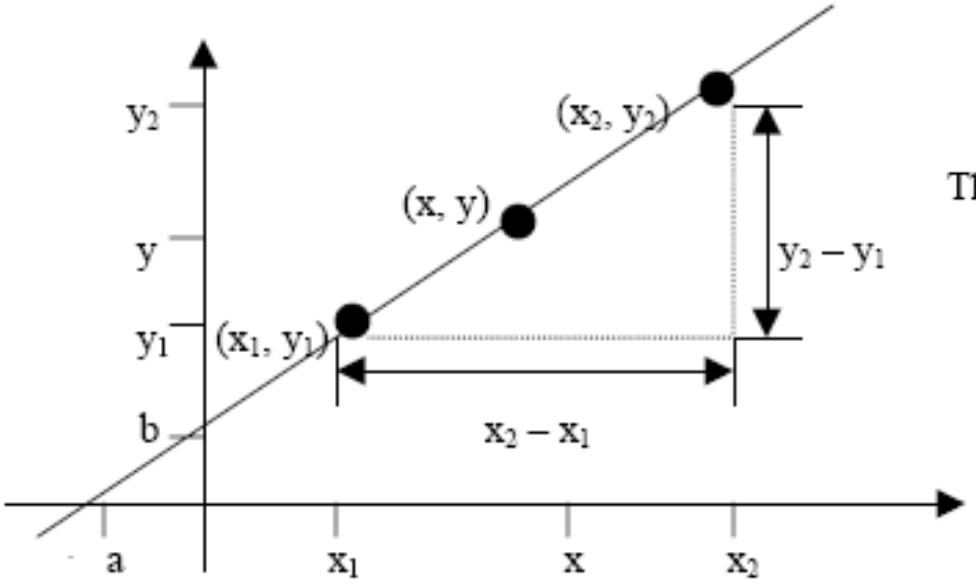
LINEAR EQUATIONS

When experimental data plot as a straight line on rectangular grid paper, the equation of the line belongs to a family of curves whose basic equation is given by:

$$y = mx + b$$

where m is the slope of the line (a constant), and b is a constant referred to as the y *intercept* (the value of y when $x = 0$).

Figure 1
The straight line established by points (x_1, y_1) and (x_2, y_2).



The *slope*, m, of this line is defined as "rise over run", or

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Problem no.1 (class work)

The velocity V of an automobile is measured at specified time t intervals. Construct a graph of the data points recorded in Table 1 (using the guidelines presented) and then draw a best fit line through the data points.

Table 1:

Time t, (s)	Velocity V (m.s)
0	24
5	33
10	62
15	77
20	105
25	123
30	151
35	170
40	188

a. **Plot the data on a Rectangular graph paper.**
b. **Determine the equation of the line using the method of selected points**
c. **Plot a computer generated graph**

Problem no.2 (class work)

The velocity *V* of an automobile is measured at specified time *t* intervals. Construct a graph of the data points recorded in Table 1 (using the guidelines presented) and then draw a best fit line through the data points.

Time, t,s	Velocity, V, m/s
1.0	5.3
4.0	18.1
7.0	26.9
10.0	37.0
14.0	55.3

a. Plot the data on a **Rectangular graph paper**.
b. Determine the **equation of the line** using the method of selected points
c. Plot a computer generated graph

Problem no.3 (class work)

The Table shows data from a trial run on the Utah Salt flats made by an experimental turbine – powered vehicle

Time, t,s	Velocity, V, m/s
10	15.1
20	32.2
30	63.4
40	84.5
50	118.0
60	139.0

a. Plot the data on a **Rectangular graph paper**.
b. Determine the **equation of the line** using the method of selected points
c. Plot a computer generated graph

Problem no.4 (class work)

The area, A, of a circle can be determined by the formula $A = \pi R^2$. If the radius, R, varies from 1cm to 10 cm, perform the following:

i.Construct a table of radius versus area mathematically. Use radius increments of 1 cm.

ii.Construct a second table of log R versus log A.

iii.Plot the values from (i) on log-log graph paper and determine the equation of the line by the method of selected points.

iv.Plot the values from (ii) on a rectangular graph paper and determine the equation of the line by the method of selected points.

Solution tips

i) Form a Table of R and A

Ii) Form a Table of log R and log A

Solution tips

i) Form a Table of R and A

Ii) Form a Table of log R and log A

RADIUS, R, cm	**AREA, $A = \pi R^2$ cm^2**
1	$A = \pi(1)^2$
2	$A = \pi(2)^2$
3	$A = \pi(3)^2$
-	-
-	-
-	-
10	$A = \pi(10)^2$

Solution tips

i) Form a Table of R and A

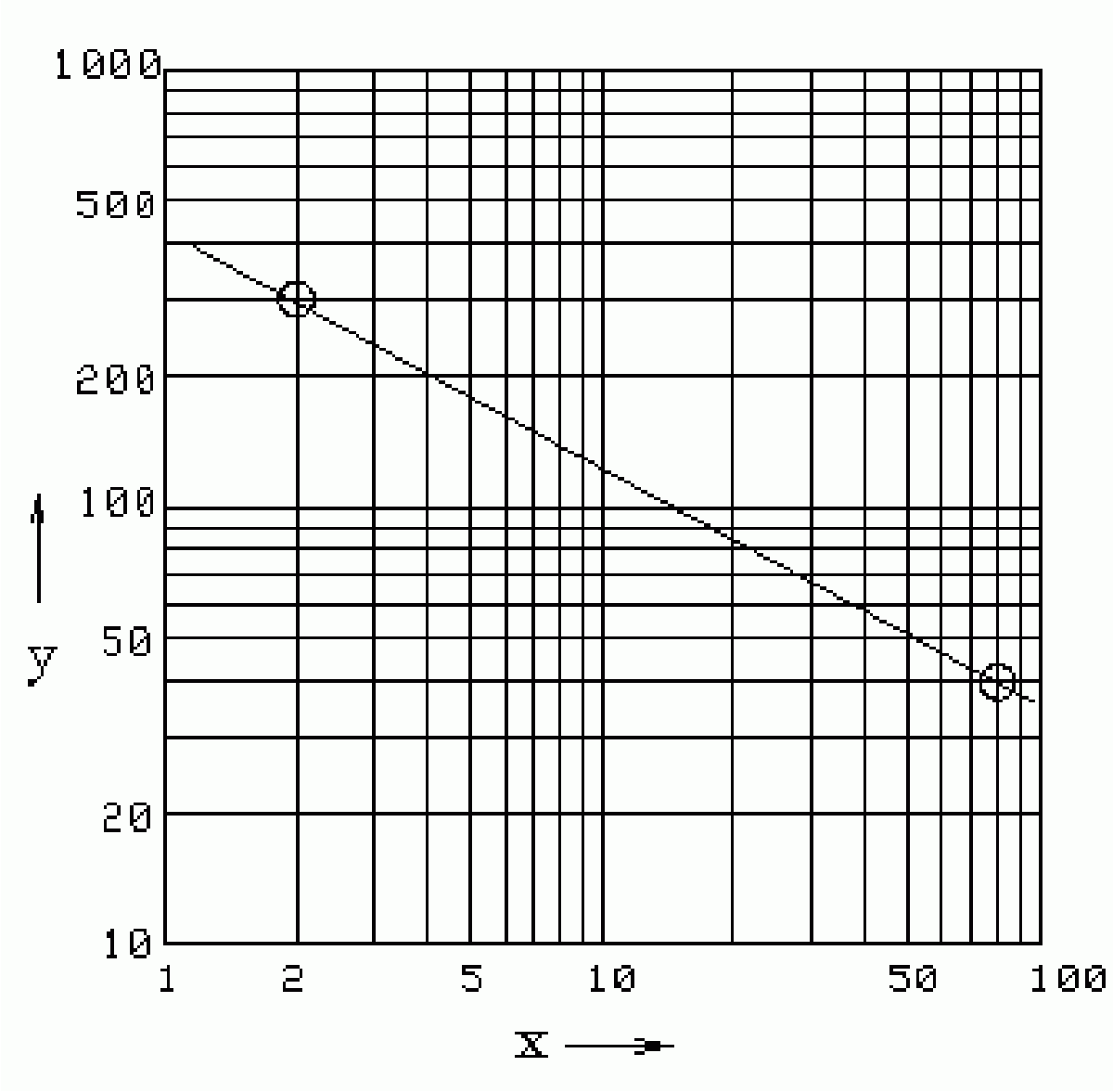
Ii) Form a Table of log R and log A

RADIUS, R, cm	**AREA, $A = \pi R^2$ cm²**
1	$A = \pi(1)^2$
2	$A = \pi(2)^2$
3	$A = \pi(3)^2$
-	-
-	-
-	-
10	$A = \pi(10)^2$

log R, cm	**log A, cm²**
log 1=	log $\pi(1)^2$ =
log 2 =	log $\pi(2)^2$ =
log 3 =	log $\pi(3)^2$ =
-	-
-	-
-	-
log 10 =	log $\pi(10)^2$

iii) Plot the values from (i) on log-log graph paper

iv) Plot the values from (ii) on a rectangular graph paper


1000
500
200
100
50
20
10
y
1
2
5
10
50
100
x

Assignment 4

Plot Computer generated graphs for **ALL Class work problems.**

Submit before or on 14/10/2010

Computer generated graph instructions

1. **Enter the data (Table) into excel sheet**
2. **Select the data**
3. **Select Insert – Scatter – with only markers**
4. ***Graph displayed***
5. **Select layout – Trend line – Linear trend line**
6. ***The best fit line displayed***
7. **Titles – Select Axis titles – Primary Horizontal title**
8. **Type the X-axis details**
9. **Similarly, enter the Y-axis details**
10. **Select Chart title – Above chart – Type the correct title**
11. **Finally <u>SAVE</u>**